

WHAT IS CLAIMED IS:

1                   1.       A pressure sensing device, comprising:  
2                    a semiconductor housing structure having an opening defined therein, said  
3 opening having a perimeter;  
4                    a thin semiconductor membrane covering the opening so as to define an  
5 enclosed cavity within the housing structure, said membrane defining a pressure sensing  
6 region within the perimeter; and  
7                    a ferromagnetic semiconductor Hall bar gage structure positioned proximal at  
8 least a portion of the perimeter of the pressure sensing region;  
9                    wherein the Hall bar gage structure produces a signal responsive to a  
10 deflection of the membrane in said pressure sensing region due to a pressure difference  
11 between the interior of the cavity and the exterior of the cavity, said signal being proportional  
12 to the pressure difference.

1                   2.       The device of claim 1, wherein the membrane includes one of GaAs  
2 and GaN.

1                   3.       The device of claim 1, wherein the Hall bar gage structure includes one  
2 of Mn doped GaAs and Mn doped GaN.

1                   4.       The device of claim 1, wherein the housing structure includes one or  
2 more of GaAs, GaN, and Si.

1                   5.       The device of claim 1, wherein the pressure sensing region of the  
2 membrane is substantially circular.

1                   6.       The device of claim 1, wherein the pressure sensing region of the  
2 membrane is substantially rectangular.

1                   7.       The device of claim 6, further including a second ferromagnetic  
2 semiconductor Hall bar gage structure positioned on the membrane away from the pressure  
3 sensing region, wherein said second Hall bar gage provides a reference signal.

1                   8.       The device of claim 7, wherein the signal and the reference signal are  
2 processed to determine one or more parameters associated with the pressure difference on the  
3 membrane in the sensing region.

1                   9.        A method of producing a ferromagnetic semiconductor-based pressure  
2 sensor, comprising:  
3                   providing a substrate;  
4                   forming an epitaxial heterostructure comprising two or more layers on the  
5 substrate;  
6                   forming a cavity in the substrate such that the cavity is exposed to a portion of  
7 a first one of said two or more layers of the epitaxial heterostructure, the exposed portion of  
8 the first layer defining a sensing region having a perimeter;  
9                   sealing the cavity;  
10                   patterning the layer adjacent the first layer so as to form a Hall bar gage  
11 structure proximal the perimeter of the sensing region and so as to expose the sensing region  
12 of the first layer to the atmosphere;  
13                  wherein the Hall bar gage structure produces a signal responsive to a  
14 deflection of the first layer in said pressure sensing region due to a pressure difference  
15 between the interior of the cavity and the exterior of the cavity, said signal being proportional  
16 to the pressure difference.

1                   10.      The method of claim 9, wherein the substrate is one of a GaAs  
2 substrate and a GaN substrate.

1                   11.      The method of claim 9, wherein the heterostructure includes GaAs in  
2 the first layer and Mn doped GaAs in the adjacent layer.

1                   12.      The method of claim 11, wherein the heterostructure further includes  
2 AlGaAs in a second layer between the first layer and the substrate, said second layer serving  
3 as an etch stop during the step of forming the cavity.

1                   13.      The method of claim 9, wherein the heterostructure includes GaN in  
2 the first layer and Mn doped GaN in the adjacent layer.

1                   14.      The method of claim 9, wherein the sensing region is substantially  
2 circular.

1                   15.      The method of claim 9, wherein the sensing region is substantially  
2 rectangular.

1                   16.     The method of claim 9, wherein sealing includes bonding the substrate  
2 to a second substrate so as to seal the cavity from the atmosphere.

1                   17.     The method of claim 9, wherein the epitaxial heterostructure is formed  
2 using molecular beam epitaxy.

1                   18.     A ferromagnetic semiconductor-based read head sensor configured to  
2 detect magnetic domain orientations in a magnetic recording medium having a plurality of  
3 domains, each domain having a magnetization, the sensor comprising:

4                   a substrate defining a plane;

5                   a ferromagnetic semiconductor epilayer formed on said substrate, said epilayer  
6 having a cubic hard axis; and

7                   first and second read current contacts, each contact coupled proximal an end  
8 of the epilayer, said contacts being configured to provide an electrical current flow along the  
9 hard axis; and

10                  one or more read probes, in electrical contact with the epilayer, configured to  
11 detect transverse magnetic resistance in the epilayer;

12                  wherein application of an in-plane magnetic field, non-aligned with the cubic  
13 hard axis, produces a transition in the transverse magnetic resistance of the epilayer, and  
14 wherein the magnetization of each domain produces a magnetic field having a component  
15 non-aligned with the cubic hard axis when the read head is positioned proximal thereto.

1                   19.     The sensor of claim 18, wherein the epilayer is substantially elongated  
2 and oriented along the cubic hard axis.

1                   20.     The sensor of claim 18, wherein the substrate is one of a GaAs  
2 substrate and a GaN substrate, and wherein the epilayer includes one of a Mn doped GaAs  
3 layer and a Mn doped GaN layer.

1                   21.     The sensor of claim 18, wherein the epilayer includes a type III-V  
2 semiconductor material.

1                   22.     The sensor of claim 18, further including at least one electric coil  
2 proximal the substrate and epilayer for generating a saturation magnetic field of desired  
3 orientation and magnitude within the epilayer.

1                   23.     A method of detecting changes in magnetic domain orientations in a  
2 magnetic recording medium using a ferromagnetic semiconductor-based read head sensor,  
3 the method comprising:

4                   positioning a read head sensor proximal a magnetic recording medium having  
5 a plurality of domains, each domain having a magnetization, wherein the read head sensor  
6 includes a ferromagnetic semiconductor epilayer structure defining a plane and having a  
7 cubic hard axis;

8                   moving the read head position relative to the domains in a sequential order;  
9 and

10                  detecting changes in the transverse magnetic resistance of the epilayer  
11 structure;

12                  wherein application of an in-plane magnetic field, non-aligned with the cubic  
13 hard axis, produces a transition in the transverse magnetic resistance of the epilayer, and  
14 wherein the magnetization of each domain produces a magnetic field having a component  
15 non-aligned with the cubic hard axis when the read head is positioned proximal thereto.

1                   24.     The method of claim 23, wherein the substrate is one of a GaAs  
2 substrate and a GaN substrate, and wherein the epilayer includes one of a Mn doped GaAs  
3 layer and a Mn doped GaN layer.

1                   25.     The method of claim 23, wherein the magnetic recording medium is  
2 substantially circular, and wherein moving includes rotating the magnetic recording medium.

1                   26.     The method of claim 23, wherein the epilayer includes a type III-V  
2 semiconductor material.

1                   27.     The method of claim 23, further including generating a saturation  
2 magnetic field of desired orientation and magnitude within the epilayer using at least one  
3 electric coil positioned proximal the substrate and epilayer.